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Land Snails from Subantarctic Islands

By R. K. DELL,

Dominion Museum, Wellington

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Abstract

THE distribution of the polytypic species *Notodiscus hookeri* (Reeve) on Kerguelen, Crozet, and Amsterdam Islands is discussed. A new subspecies is described from Heard Island. The relationships of *Phrixgnathus hamiltoni* (Suter) from Macquarie Island are shown to be with New Zealand.

INTRODUCTION

SOME land mollusca collected from Macquarie Island and Heard Island by the Australian National Antarctic Research Expedition have been sent to the writer for identification and report by Miss J. H. Macpherson, of the National Museum of Victoria.

SYSTEMATICS

Family ENDODONTIDAE

Genus NOTODISCUS Thiele, 1931

1931. Handbuch der Systematischen Weichtierkunde, p. 575.

Type species (monotypy) *Helix hookeri* Reeve.

Notodiscus hookeri hookeri (Reeve, 1854), Figs. 3, 4.

1854. *Helix hookeri* Reeve, Conch. Icon. *Helix*, Pl. 208, fig. 1474.
1876. *Helix hookeri*: Studer, Verhandl. d. Gesellsch. fur. Erdkunde zu Berlin, 3, p. 165.
1877. *Patula hookeri*: Martens, Monatsber. der konigl. Acad. wiss. Berlin, 1877, p. 269, Pl. 2, figs. 5–10.
1877. *Helix* (*Patula*) *hookeri*: Smith, Phil. Trans. Roy. Soc. London, 168, p. 183.
1879. *Helix hookeri*: Studer, Arch. f. naturgesch. 45, p. 111.
1887. *Helix* (*Amphidoxa*) *hookeri*: Tryon, Man. Conch. (2), 3, p. 48, Pl. 5, fig. 83.
1931. *Endodonta* (*Amphidoxa*) *hookeri*: Lamy, Bull. Mus. Hist. Nat. (2) 3, p. 518.
1931. *Notodiscus hookeri*: Thiele, Handb. Syst. Weich. p. 575.
1954. *Endodonta hookeri*: Gaillard, Bull. Mus. Hist. Nat. 26, p. 524.
1957. *Notodiscus hookeri*: Powell, B.A.N.Z.A.R. Exped. B. 6, p. 138.

This species, for which Thiele created the genus *Notodiscus*, has been known from Kerguelen for over 100 years. The occurrence of an endemic genus of land snails on Kerguelen, isolated as it is in the South Indian Ocean, is interesting

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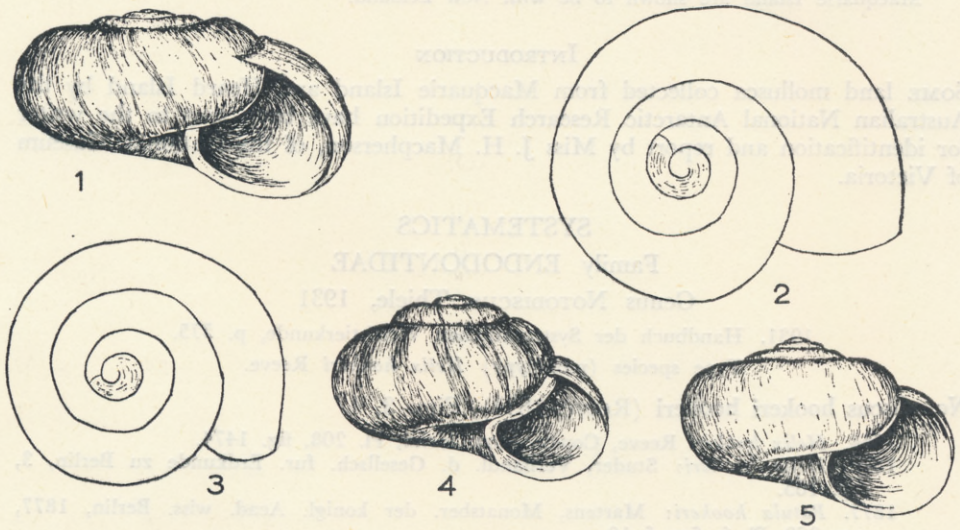
enough, but Gaillard (1954) recorded it (as *hookeri*) from Possession Island in the Crozets and from New Amsterdam. The writer has examined specimens from these last two localities in the National Museum of Natural History in Paris and can confirm Gaillard's identifications. However, the writer did not have time to measure specimens and carry out critical comparisons. The discovery of an allied form from Heard Island, with significant differentiating characters, makes a re-examination of the material from the Crozets and Amsterdam of urgent interest. It is possible that these latter may represent other subspecies. In any case all the forms are close enough to consider the whole series as belonging to a single polytypic species.

Notodiscus hookeri heardensis, n. subsp. Figs. 1, 2.

Shell of same type as *N. hookeri hookeri* but differing in the laxer coiling of the whorls which results in a shell wider in proportion. There is some variation in the relative proportions both of the shells from Kerguelen (*hookeri hookeri*) and those from Heard, but there is very little overlap and the means are well separated. The proportionate width of the umbilicus varies in both populations, but this variation is caused largely by the encroachment of the columella across the umbilicus in adult shells. There does not seem to be any significant difference between the two forms in this respect.



FIGS. 1, 2.—*Notodiscus hookeri heardensis* n. subsp., holotype, 6.9 × 3.8 mm.
FIGS. 3, 4.—*Notodiscus hookeri hookeri* (Reeve), Kerguelen Island, 5.5 × 4.0 mm (to same scale as Figs. 1 and 2).
FIG. 5.—*Phrixgnathus hamiltoni* Suter, lectotype, 2.2 × 1.4 mm.

LOCALITIES. Atlas Cove, Heard Island, on Kerguelen Cabbage, (*Pringleya antiscorbutica*), 25.2.1951 (Type); Laurens Peninsula, Heard Island, 24.3.1953; near Red Island, Heard Island; West Bay, Heard Island, amongst moist broken rock, 12.1.1950.

Holotype (F.23571) and Paratypes in National Museum of Victoria, and Paratypes in Dominion Museum, Wellington.

Major diameter 6.9 mm, height 3.8 mm (Holotype).

MEASUREMENTS OF *NOTODISCUS*.

Height Index (H.I.) is the height of the shell expressed as a percentage of the diameter; Umbilical Index (U.I.) the diameter of the umbilicus expressed as a percentage of the diameter of the shell.)

	Major Diameter mm	Dia. of Umbilicus mm	Ht. mm	H.I.	U.I.
N. hookeri hookeri					
Kerguelen	5.5	.8	4.0	69	15
Kerguelen	5.3	.6	3.2	61	11
Kerguelen	5.4	.8	3.5	66	15
Kerguelen	4.7	.6	3.0	63	13
Kerguelen	4.3	.5	2.7	63	12
Kerguelen	4.3	.6	2.8	65	14
Kerguelen	4.3	.6	2.4	56	14
N. hookeri heardensis					
Atlas Cove, Heard Island	7.2	1.1	3.7	51	15
Atlas Cove, Heard Island	6.5	1.0	3.5	51	15
Atlas Cove, Heard Island	5.1	.5	3.0	49	9
Laurens Peninsula	5.8	.8	3.4	59	13
Laurens Peninsula	5.7	.8	2.8	49	14
Laurens Peninsula	5.0	.8	3.0	60	16
West Bay, Heard Island	7.7	1.5	4.2	54	19
West Bay, Heard Island	6.4	.7	3.5	55	11
West Bay, Heard Island	7.4	1.1	3.8	52	15

Ranges and means of Indices (means in parentheses).

	Height Index	Umbilical Index
N. hookeri hookeri (7 specimens)	56–69 (63)	11–15 (13)
N. hookeri heardensis (9 specimens)	49–60 (53)	9–19 (14)

Family LAOMIDAE

Genus PHRIXGNATHUS Hutton, 1883

1883. *Trans. N.Z. Inst.*, 15, p. 136.
Type species (original designation) *Helix fatua* Hutton = *Phrixgnathus celia* Hutton.

Phrixgnathus hamiltoni Suter, 1896, Fig. 5.

1896. *Laoma* (*Phrixgnathus*) *hamiltoni* Suter, Proc. Malac. Soc. London, 2, p. 37, Pl. 4, figs. 22–24.

1913. *Laoma* (*Phrixgnathus*) *hamiltoni* Suter, Manual N.Z. Moll., p. 753, Pl. 10, figs. 11a-b.

1916. *Phrixgnathus hamiltoni*: Hedley, Austral. Ant. Exped., 1911–1914, Sci. Rep. C, 4, p. 62.

1955. *Phrixgnathus hamiltoni*: Powell, N.Z. Dept. Sci. Ind. Res. Cape Exped. Ser. 15, p.

LOCALITIES. Near the Nuggets, Macquarie Island, N. Haysom, 3.1.1950, crawling on stems of *Stilbocarpa* and amongst humus; south end of isthmus, Macquarie Island, A. M. Gwynn, 26.1.1950, stems of *Stilbocarpa polaris*.

This is the only species of land snail known from Macquarie Island. The relationships are obviously with New Zealand. The genus *Phrixgnathus* is very well represented on the New Zealand mainland, some 47 species having been described. It seems certain that, when full anatomical studies have been carried out, some of these will be allocated to distinct subgeneric or generic groups. Four species from the southern islands have been grouped in the subgenus *Taguahelix* by Powell (1955). The Macquarie snails are not allied to *Taguahelix*. The writer (Dell, 1954), described two forms of *Phrixgnathus, P. rakiura* and *P. rakiura solanderi* from Stewart Island and Solander Island, respectively. These are obvi-

ously allied to *hamiltoni*. *Phrixgnathus campbellica* (Filhol) from Campbell Island is an uncertain species. The original description is inadequate and the type has never been figured. The writer (Dell, 1954, p. 149, fig. 3) figured a shell from Campbell Island as *campbellica*. Powell (1955, p. 126, Pl. 4, fig. 31) applied the name *campbellica* to a completely different species and included it in his subgenus *Taguahelix*. The true identity of *campbellica* will only be determined when the type can be re-examined. However, in the meantime the shell figured by Dell from Campbell Island is undoubtedly very close to *hamiltoni*, differing largely in the slightly narrower umbilicus.

	Diameter mm	Height mm	Height of Spire mm	Dia. of Umbilicus mm
Lectotype	2.2	1.4	0.4	0.3
Syntype	2.1	1.2	0.2	0.3
S. end of isthmus	2.2	1.4	0.3	0.3
S. end of isthmus	2.3	1.5	0.5	0.3
S. end of isthmus	2.2	1.5	0.5	0.3
Ranges and means of Height Indices			57–68 (64)	
Ranges and means of Spire Indices			17–33 (24)	
Ranges and means of Umbilical Indices			13–14 (14)	

Family LIMACIDAE

Genus AGRIOLIMAX Moerch, 1865

1865. *J. Conchyliol.*, 13, p. 378.

Type species (monotypy) *Limax agrestis* Linnaeus.

Agriolimax reticularis Mueller, 1774.

1774. *Limax reticularis* Mueller, Vermium terrestrium et fluviatilium . . . Historiae, p. 10.

1960. *Agriolimax reticularis*: Quick, Bull. Brit. Mus. (Nat. Hist.) Zool. 6, p. 164.

This European slug was known for many years as *Agriolimax agrestis* L. It is the commonest British slug and has been spread widely around the world. Macquarie Island must be one of the remotest islands to which it has been introduced. Hedley (1916, p. 62) appears to have been the first to record it from Macquarie, where it had no doubt been introduced accidentally by resident sealers. It now appears well established.

LOCALITIES. Macquarie Island, —.12.1948; and —.1.1949; The Nuggets, Macquarie Island, N. Haysom, 3.1.1950, in rotting humus beneath vegetation; Gadget Gully, N. Haysom, 8.2.1950, crawling on rocks; Gadget Gully, A. M. Gwynn, 12.12.1949, on rocks.

DISCUSSION

The southern tip of South America and the Falklands support a relatively sparse land snail fauna, the true affinities of which do not appear to be well known. No land snails are known from South Georgia. Apart from the South American area the only land snails known from the Subantarctic are the species mentioned above. It has been shown that *Phrixgnathus hamiltoni* belongs to the same genus as a highly characteristic group of New Zealand snails and that related species occur in southern New Zealand and at Campbell Island. *Notodiscus hookeri* extends from the Crozets to Amsterdam, Kerguelen and Heard. No close relations are known and the genus is confined to these island groups. It will be most interesting to check if *Notodiscus* occurs on Prince Edward Island and on St. Paul.

Taylor (1954) discussing the origins of the vascular flora of Macquarie Island, makes the following points:

1. The island is of volcanic origin, probably emerging during the Cretaceous.
2. During the Pleistocene, the island was covered by a thick ice cap, there being no evidence of any ice-free area during the glaciation.
3. It seems unlikely that any of the plants at present living on Macquarie could have survived the glaciation.
4. The present flora must have resulted from post-glacial immigration.

Macquarie Island therefore provides a very useful example in discussions of the possibilities of trans-oceanic dispersal of terrestrial animals. The period since the last major glaciation is too short and the oceanic depths are too great to envisage eustatic sea-level changes of sufficient magnitude to connect Macquarie with any other land mass. The last glaciation in New Zealand (20,000 years ago) is thought to have resulted in a fall in sea level of about 350 feet (Fleming, 1962, p. 87).

In addition to the vascular flora, the present terrestrial animals of Macquarie must have been derived by trans-oceanic dispersal by one means or another. In the case of *Phrixgnathus*, New Zealand is obviously the donor area. It seems impossible for a pulmonate land snail to have been carried by sea transport so that some form of aerial transport must be invoked to explain its presence on Macquarie. Taylor was able to show that the seeds of many of the vascular plants now living on Macquarie could be carried by birds. Falla (1960) has elaborated this theme of transport of seeds in the down remaining on newly fledged petrels, and shown the possibilities. There is one general difficulty in postulating petrels as a transporting agent from one island to another. That is that petrels in general only come ashore on the one island to breed and spend the rest of the year at sea. Young birds which have only recently taken to the wing do, however, fairly regularly come ashore exhausted in areas well separated from their breeding grounds. Falla has listed a number of known examples and many more must occur in nature. It is these very birds which would be most likely to be able to transport plant seeds and even live animals in the down. No concrete evidence is known, but it seems most probable that bird transport from the New Zealand area has been responsible for the establishment of *Phrixgnathus* on Macquarie Island. That there would be no major difficulty in such a species establishing itself there is partly shown by the facility with which the introduced slug *Agriolimax reticulatus* has become acclimatised on Macquarie. This slug has established itself in many parts of the world, but Macquarie must rate as a borderline habitat ecologically. In New Zealand, where *Agriolimax* is also well established, it is still only found in abundance in areas where the original native habitat has been greatly disturbed by farming or gardening activities. It is found in native bush, but only along the outskirts and where the original bush cover has been modified. On Macquarie it undoubtedly established itself in and around the huts of the early sealing gangs, but it is now well established in areas which are largely unchanged by man. Such an invasion of a very different ecological niche could only be possible if the niche was largely unoccupied already, and on Macquarie, with its very meagre terrestrial fauna such conditions appear to have been present.

It is, of course, vaguely possible that the *Phrixgnathus* was accidentally introduced by man. There was considerable traffic between New Zealand and Macquarie during the period 1872 to 1894 and woodhens of the genus *Ocydromus* were introduced from New Zealand as early as 1872. These were taken from Stewart Island, and as has been shown, a closely allied species of *Phrixgnathus*

occurs on Stewart Island. The first specimens of *Phrixgnathus hamiltoni* were apparently collected at Macquarie in 1894, and it seems too short a period of time to envisage a species establishing itself in numbers and differentiating sufficiently from the parent stock to be recognisably distinct.

As regards the distribution of *Notodiscus*, the occurrence on Amsterdam is at first sight anomalous. Skottsberg (1960, pp. 448–9) has proposed a codification of southern plant distribution areas. This comprises eight zones, number 2 being a Sub-Antarctic Zone divided into a Magellanian and a Kerguelen Province. The latter province includes Prince Edward, Crozets, Kerguelen and Heard Islands. Number 8 Skottsberg called a zone of Afro-Indian outposts comprising Africa, Madagascar, Mascarene Islands, St. Paul and Amsterdam Islands. Such a classification based upon terrestrial plants would fit what we know of the zoogeography of the area except that the fauna of St. Paul and Amsterdam includes some circumpolar subantarctic marine elements and some elements which link it to Tristan da Cunha and Gough Islands in the South Atlantic (Wace, 1960). However, in discussing the relationships of the fauna of the mid-Atlantic islands, Holdgate (1960, p. 563-6) considers probable methods by which specialised southern faunal elements retreated to the north during glacial periods and have since re-invaded such islands as Kerguelen, Heard and the Crozets. Holdgate concludes, " The explanation must be sought in the retreat of this specialised fauna and flora northwards during the glacial periods, perhaps to Amsterdam and St. Paul Islands, which lie on the Kerguelen Ridge and are unlikely to have been affected by ice." It would certainly appear that Heard, Kerguelen and the Crozets were completely covered by ice during the last glaciation and that the present flora and fauna is essentially post-glacial in origin. Mellor (1959) has indicated that the retreat of ice in the South Indian Ocean dates from about 15,000 years ago. Although St. Paul and Amsterdam do not appear to have been glaciated their climatic zone during the last glaciation would have been considerably lowered.

Leaving actual mechanism out of consideration at the moment, such movements could well have accounted for the present distribution of *Notodiscus*. There does not seem to be any necessity for postulating that *Notodiscus* originated in the Kerguelen-Heard-Crozet area. It could equally well have developed on St. Paul-Amsterdam and have since dispersed southwards after the last glaciation. This requires only transoceanic dispersal in one way—i.e., from St. Paul-Amsterdam to Kerguelen and the Crozets and from Kerguelen to Heard.

If trans-oceanic migrations of this magnitude have been possible for *Notodiscus* and on all the evidence this seems inescapable, then carriage by birds once again seems the only possible mechanism. As the climatic zones were pushed north during the last glaciation, the species of sea birds nesting on the Subantarctic Islands would also have moved north so that the species now nesting on St. Paul and Amsterdam would not necessarily be the same as those responsible for post-glacial transport. At the same time, two species of mollymawks (*Diomedea*) now nest on St. Paul together with Sooty Albatross and a species of *Pachyptila* and any, or all, of these could have been responsible.

At present this evidence is not very conclusive, although taken in conjunction with that summarised by Holdgate (1960) it is certainly very indicative of possible trends in post-glacial times. What is important, however, is to establish the principle that trans-oceanic transportation is possible for a non-flying terrestrial invertebrate, and in the case of *Notodiscus* this fact seems amply proven.

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DR R. K. DELL,
Dominion Museum,
Private Bag, Wellington.